What Is Claimed Is:

1. (Overall method claim) A method of optical communication, comprising the steps of:

providing a quadrature modulated optical data signal, the optical data signal including two data bands separated in frequency, each data band having in-phase and quadrature components;

during transitional states of the quadrature modulated optical data signal in which data symbols change in value, reducing the power to zero such that transmitted power decreases to zero at approximately a mid point of the transitional states;

combining the optical data signal with a side carrier at a single frequency between the two data bands of the optical data signal;

transmitting the combined optical data signal;

receiving the combined optical data signal;

separating the side carrier from the two data bands of the combined optical data signal;

increasing an amplitude of the side carrier;

modulating the side carrier into two shifted side carriers, one of the two shifted carriers being shifted in frequency to the middle of each of the respective two data bands; and

correcting for polarization mode dispersion on the combined signal by adjusting a polarization state of each of the two shifted side carriers to match a polarization state of the one of the two data bands at which the respective shifted side carrier is centered.

2. The method of claim 1, further comprising the steps of:

separating the in-phase and quadrature components of the two data bands after optoelectric conversion; and

after optoelectric conversion, compensating for chromatic dispersion by applying a corrective function to each of the in-phase and quadrature components of the data bands, the corrective function precisely counteracting the effects of chromatic

dispersion on the in-phase and quadrature components.

3. The method of claim 1, further comprising the steps of:

before transmission, separating signals in quadrature in each of the two data bands of the combined optical data signal into separate first and second signals; and

inputting the first and second signals into respective first and second channels of a dense wave division multiplexer.

4. The method of claim 1, further comprising the step of:

before transmission, reducing an amplitude of the side carrier.

5. The method of claim 1, wherein the step of compensating for polarization mode dispersion on the combined signal includes the steps of:

mixing the optical data signal with one of the two shifted side carriers, the shifted side carrier having a second polarization state;

adjusting the second polarization state of the shifted side carrier;

determining, through feedback from the mixing step, whether the adjustment to the second polarization state of the carrier signal has brought the second polarization state in alignment with the first polarization state; and

repeating the previous steps until the second polarization state is in alignment with the first polarization state.

6. The method of claim 1, wherein the step of compensating for polarization mode dispersion on the combined signal includes the steps of:

mixing the optical data signal with one of the two data bands of the optical data signal, the one of the two data bands having a first polarization state;

adjusting the first polarization state of the one of the two data bands;

determining, through feedback from the mixing step, whether the adjustmnet to the first polarization state of the one of the two data bands has brought the first polarization state in alighment with the second polarization state; and

repeating the previous step until the first polarization state is in alignment with

the second polarization state.

7. The method of claim 3, further comprising the steps of:

during modulation, imprinting a first data signal in-phase and a second data signal in quadrature phase onto two data channels on data bands of a first quadrature modulated optical data signal;

during modulation, imprinting a third data signal in-phase and a fourth data signal in quadrature-phase onto each of two data channels on data bands of a second quadrature modulated optical data signal;

encoding the first modulated optical data signal with a first polarization state; and

encoding the second modulated optical data signal with a second polarization state.

8. The method of claim 7, further comprising the steps of:

combining the first and second quadrature modulated optical data signals;

separating the first and second quadrature modulated optical data signals according to polarization state, the first and second data channels in the data bands having a first polarization state, the third and fourth data channels in the data bands having a second polarization state;

before transmission, filtering the separated signals according to frequency.

9. The method of claim 1, wherein after reception, the side carrier is separated from the two data bands of the combined optical data signal by filtering the combined optical signal using a Fabry-Perot resonator.

10. The method of claim 1, further comprising the step of:

prior to transmission, modulating the side carrier with an identification code, the identification code including information concerning a transmitter performing the step of transmitting the combined optical data signal.

11. The method of claim 10, further comprising the steps of:

separating the in-phase and quadrature components of the two data bands after optoelectric conversion; and

compensating for chromatic dispersion by applying a corrective function to each of the in-phase and quadrature components of the data bands, the corrective function precisely counteracting effects of chromatic dispersion on the in-phase and quadrature components;

wherein the information concerning a transmitter includes parameters used in the corrective function to precisely counteract the effects of chromatic dispersion.

12. A method of reducing the transmitted power of a quadrature modulated optical data signal, comprising the steps of:

providing a quadrature modulated optical data signal; and

during transitional states of the quadrature modulated optical data signal in which data symbols change in value, reducing the power to zero such that transmitted power decreases to zero at approximately a mid point of the transitional states;

13. The method of claim 11, further comprising the steps of:

combining the quadrature modulated optical data signal with a side carrier; and

transmitting the side carrier with the quadrature modulated optical data signal.

14. A method of improving a signal-to-noise ratio of a received optical data signal, the optical data signal including a side carrier and data bands, the method comprising the steps of:

isolating the side carrier from the data bands;

increasing an amplitude of the side carrier; and

recombining the side carrier with the data bands, the amplitude of the side carrier being increased relative to the data bands.

15. The method of claim 14, wherein the side carrier is isolated from the data bands by filtering the optical data signal using a Fabry-Perot resonator.

16. A method of compensating a quadrature modulated optical data signal for effects of chromatic dispersion occurring during transmission over optical fiber, the method comprising the steps of:

separating in-phase and quadrature components of the optical data signal;

optoelectrically converting the in-phase and quadrature components of the optical data signal into in-phase and quadrature data signals;

applying a corrective function to the in-phase and quadrature data signals, the corrective function modifying the in-phase and quadrature data signals in a manner that precisely counteracts effects of chromatic dispersion on the in-phase and quadrature components of the optical data signal.

17. The method of claim 16, wherein the corrective function is a function of a coefficient of fiber dispersion, a length of the optical fiber, and frequency of the optical data signal.

18. A method of compensating for effects of polarization mode dispersion on an optical data signal, comprising the steps of:

receiving an optical data signal having data bands, the data bands having a first polarization state;

mixing the optical data signal with a carrier signal, the carrier signal having a second polarization state;

adjusting the second polarization state of the carrier signal;

determining, through feedback from the mixing step, whether the adjustment to the second polarization state of the carrier signal has brought the second polarization state in alignment with the first polarization state; and

repeating the previous steps until the second polarization state is in alignment with the first polarization state.

19. The method of claim 18, wherein the data bands include a first data band and a second data band, the first data band having first and second data channels in quadrature, the second data band having third and fourth data channels in quadrature,

and the carrier signal includes a first side carrier and a second side carrier, the first side carrier being at a center of the first data band, the second carrier being at a center of the second data band.

20. The method of claim 18, further comprising:

duplicating the carrier signal;

shifting the duplicated signal in phase by ninety degrees;

combining the optical data signal with the carrier signal into an in-phase optical signal;

combining the optical data signal with the duplicated signal into an 90-degree shifted optical signal;

optoelectrically converting the in-phase optical signal and the 90-degree shifted optical signal into first and second product signals; and

providing the first and second products signals as feedback to respective first and second polarization controller units.

21. A method of simulating homodyne reception in a receiver without the use of a local oscillator, comprising the steps of:

receiving an optical data signal having at least one data band occupying a range of frequencies and a side carrier; and

shifting a frequency of the side carrier to a frequency in the middle of the range of frequencies of the at least one data band.

22. A method of providing information concerning a transmission device, comprising the steps of :

providing an optical data signal having data bands and a side carrier;

modulating the side carrier with an identification code, the identification code including information concerning the transmitter; and

transmitting to a receiver, the optical data signal including the side carrier.

23. A method of boosting an amplitude of a side carrier relative to data bands in an

optical data signal by harnessing Stimulated Brillouin Scattering, comprising the steps of:

splitting the optical data signal, the optical data signal traveling through first and second optical paths;

filtering the optical data signal in the first data path, the data bands being filtered and the side carrier being passed;

modulating the passed side carrier with an approximately 11 GHz signal, the side carrier being shifted approximately up 11 GHz in frequency to an up-shifted carrier, and the side carrier being shifted approximately down 11 GHz to a down-shifted carrier; and

transmitting the up-shifted carrier to the second optical path in a direction opposite to the transmission of the optical data signal along the second optical path;

wherein the up-shifted carrier collides with the optical data signal in the second optical path, generating Stimulated Brillouin Scattering, the Scattering boosting the amplitude of the side carrier of the optical data signal traveling in the second optical path.

24. An optical data signal transmitter comprising:

a Mach-Zender modulator, the Mach-Zender modulator receiving an input optical signal and modulating a pair of side carriers onto the input optical signal, outputting an optical carrier signal; and

at least two phase modulators, the at least two phase modulators receiving the optical carrier signal and each generating an optical data signal by modulating a pair of data signals onto at least two data bands;

wherein the data bands are spread in frequency when modulated onto the optical carrier signal, the spreading causing an amplitude of the optical data signal to be reduced to zero during transitions between data symbols.

25. The transmitter of claim 24, further comprising:

a second Mach-Zender modulator, the second Mach-Zender modulator imprinting the input optical signal with an identification code to generate a TX ID, the identification code including information concerning the transmitter; and

a combiner, the combiner attaching the TX ID to the optical data signal.

26. The transmitter of claim 25, further comprising:

a polarization transformer;

wherein the at least two phase modulators generate a first optical data signal including data bands imprinted with a first pair of data channels, the first optical data signal having a first polarization state, and a second optical data signal including data bands imprinted with a second pair of data channels, the second optical data signal having a first polarization state, the polarization transformer altering a polarization state of the first optical data signal from the first polarization state to a second polarization state.

27. The transmitter of claim 26, further comprising

a dense wave division multiplexing unit; and

means for separating the first pair of data channels from the second pair of data channels based upon differing polarization states of the first and second optical data signals;

wherein the first and second pairs of data channels are input to separate channels of the dense wave division multiplexing unit.

28. The transmitter of claim 24, wherein the pair of side carriers is modulated onto the input optical signal at both above an below a reference frequency of the input optical signal.

29. The transmitter of claim 28, wherein a first side carrier of the pair of side carriers is modulated onto the input optical signal at 30 Ghz above and below the reference frequency, and a second side carrier of the pair of side carriers is modulated onto the input optical signal at 20 Ghz above and below the reference frequency.

30. A method comprising the steps of:

transmitting a side carrier along with data in an optical signal over an optical

fiber; and

upon reception, using the side carrier to boost signal-to noise performance.

31. The method of claim 30, further comprising the step of:

boosting the side carrier relative to the data;

shifting the side carrier in frequency to the center of the data;

optionally correcting for polarization mode dispersion between the data and the side carrier; and

mixing the centered side carrier with the data in a photoconverter.

wherein mixing the centered and boosted side carrier with the data improves signal-to-noise performance.

32. A receiver for receiving and processing an optical data signal, the optical data signal including at least two data bands and at least one side carrier, each of the at least two data bands including a pair of quadrature modulated data signals, the receiver comprising:

a side carrier boosting module, the side carrier boosting module increasing an amplitude of the at least one side carrier relative to the at least two data bands;

a side carrier shifting module coupled to the side carrier boosting module, the side carrier shifting module shifting the at least one side carrier into at least two shifted carriers, each of the at least two shifted carriers shifted to a center of one of the at least two data bands; and

means for compensating polarization mode dispersion coupled to the side carrier shifting module, the means for compensating adjusting a polarization state of one of:

a) each of the at least two shifted carriers to match a polarization state of one of the at least two data bands; and

b) the at least two data bands to match a polarization state of the at least two shifted carriers.

33. The receiver of claim 32, wherein the side carrier boosting module includes:

a splitter for splitting the received optical data signal and transmitting the optical

data signal into an upper branch and a lower branch;

a Fabry-Perot resonator coupled to the upper branch for filtering the at least one side carrier from the at least two data bands in the optical data signal fed to the upper branch;

an attenuator coupled to the lower branch for attenuating the optical data signal transmitted via the lower branch;

a combiner coupled to both the upper and lower branches, the combiner combining and outputting the optical data signals transmitted via each of the upper and lower branches; and

an optical amplifier coupled to the combiner for amplifying the output of the combiner;

wherein an amplitude of the at least one side carrier is increased relative to an amplitude of the at least two data bands.

34. The receiver of claim 32, wherein the side carrier boosting module includes:

a splitter for splitting the received optical data signal and transmitting the optical data signal into an upper branch and a lower branch; and

a Fabry-Perot resonator coupled to the upper branch for filtering the at least one side carrier from the at least two data bands in the optical data signal fed to the upper branch;

a modulator coupled to the Fabry-Perot resonator for modulating an 11 GHz signal onto the at least one side carrier output from the Fabry-Perot resonator;

a further Fabry-Perot resonator coupled to an output of the modulator for selecting a frequency 11 GHz above the at least one side carrier; and

a circulator coupled to both an output of the further Fabry-Perot resonator and the lower branch, the circulator sending the output of the further Fabry-Perot resonator in along the lower branch in a direction opposite to a transmission direction of the optical data signal;

wherein the optical data signal collides with the output of the further Fabry-Perot resonator inducing a Stimulated Brillouin Scattering effect, the effect enhancing an amplitude of the at least one side carrier in the optical data signal relative to an

amplitude of the at least two data bands in the optical data signal.

35. The receiver of claim 34, wherein the side carrier boosting module includes:

an amplifier for amplifying the output from the further Fabry-Perot resonator;

an isolator in the lower branch downstream of the splitter, the isolator blocking the progress of the output from the further Fabry-Perot resonator along the lower branch; and

dispersion compensating fiber coupling the circulator with the isolator along the lower branch, the dispersion compensating fiber enhancing Stimulated Brillouin Scattering events occurring within the fiber.

36. The receiver of claim 32, further comprising:

a chromatic dispersion compensation stage, the chromatic dispersion stage receiving as input in-phase and quadrature-phase signals of the quadrature modulated data signals, the chromatic dispersion correction stage including:

a first splitter for splitting the input in-phase signal into a first branch and a second branch;

a first COS circuit coupled to the first splitter for applying a COS transfer function to the in-phase signal in the first branch;

a first SIN circuit coupled to the first splitter for applying a first SIN transfer function to the in-phase signal in the second branch;

a second splitter for splitting the input quadrature-phase signal into a first quadrature branch and a second quadrature branch;

an inverter coupled to the second quadrature branch for changing the phase of the quadrature signal in the second branch 180 degrees;

a second COS circuit coupled to the first splitter for applying a COS transfer function to the quadrature signal in the first branch;

a second SIN circuit coupled to the first splitter for applying a SIN transfer function to the quadrature signal in the second branch;

a first combiner for combining output from the first SIN circuit with output from the second COS circuit into a corrected quadrature output signal; and

a second combiner for combining output from the first COS circuit with output from the second SIN circuit into a corrected in-phase output signal.

~~38~~ 37. The receiver of claim 37, wherein the received optical data signal includes a transmitter identification code embedded in one of the at least one side carrier and the chromatic dispersion compensation stage further includes:

a chromatic dispersion module coupled to an input for receiving the transmitter idenification and also coupled to the first and second COS circuits and the first and second SIN circuits;

wherein the chromatic dispersion module is operative to transmit signals to the first and second COS circuits and the first and second SIN circuits, the signal effectuating adjustments to the respective transfer functions applied by the first and second COS circuits and the first and second SIN circuits in accordance with information extracted from the transmitter identification.

~~39~~ 38. The receiver of claim 38, wherein the extracted information includes information describing the location of a transmitter from which the received optical data signal originates.

~~40~~ 39. The receiver of claim 38, wherein the first and second COS circuits and the first and second SIN circuits include microstrip elements, the microstrip elements having variable lengths and widths and modifying input signals according to the variable lengths and widths.

~~41~~ 40. The receiver of claim 32, wherein means for compensating polarization mode dispersion include:

a frequency filter coupled to an output of the side carrier shifting module; and

at least two polarization controllers, the at least two polarization controllers coupled to the frequency filter and to a photodetector output, each polarization controller receiving one of the two shifted side carriers and altering a polarization state of the received shifted side carrier to match a polarization state of the data band at

which the shifted side carrier is centered, the polarization state of the data band being received via feedback from the photodetector output.

41 ~~42~~. The receiver of claim 41, further comprising:

a phase shifter coupled to and receiving output side carriers from the at least two polarization controllers, the phase shifter splitting the received shifted side carrier signals into a first branch and a second branch, the second branch signal being shifted 90 degress with respect to the first branch signal;

a first combiner for combining the first branch with the data bands of the optical data signal;

a second combiner for combining the second branch with the data bands of the optical data signal; and

a first demultiplexer coupled to the first combiner and filtering output from the first combiner into first and second in-phase channels according to frequency, the first and second in-phase channels each including a data band and a shifted side carrier;

a second demultiplexer coupled to the second combiner and filtering output from the second combiner into third and fourth quadrature-phase channels according to frequency, the third and fourth quadrature-phase channels each including a data band and a shifted side carrier; and

at first set of photodetectors coupled to the first demultiplexer for optoelectrically converting the first and second in-phase channels; and

a second set of photodetectors coupled to the second demultiplexer for optoelectrically converting the third and fourth quadrature-phase channels;

wherein output from the first and second set of photodetectors is provided to the at least two polarization controllers, the polarization controllers match polarization states of the first, second, third and fourth channels with the respective side carrier within each of the channels.

42 ~~43~~. The receiver of claim 42, wherein the first and second demultiplexers are dense wave division demuliplexers.

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~~44~~. A method of correcting a quadrature modulated optical data signal for effects of chromatic dispersion comprising the steps of:

deriving in-phase and quadrature data signals via a homodyne reception system; and

applying a corrective function to the in-phase and quadrature data signals, the corrective function modifying the in-phase and quadrature data signals in a manner that precisely counteracts effects of chromatic dispersion on the in-phase and quadrature components of the optical data signal.

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~~45~~. A method of multichannel optical communication comprising the steps of:

providing a plurality of quadrature modulated optical data signals, each optical data signal having data bands, each optical data signal occupying a single frequency channel;

combining each of the plurality of optical data signals with one of a plurality of side carriers, each of the plurality of side carriers positioned near a center of each respective frequency channel;

reducing amplitudes of each of the plurality of side carriers;

multiplexing the plurality of combined optical data signals into a multichannel optical data signal;

transmitting the multichannel optical data signal;

receiving the multichannel signal;

separating out the side carrier from the data bands in each channel fo the multichannel signal;

increasing the amplitude of each of the plurality of separated side carriers; and

shifting a frequency of each of the plurality of separated side carriers, each side carrier shifted to centers of the data bands within the same channel as the side carrier to emulate homodyne reception.

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~~46~~. The method of claim 45, wherein each frequency channel occupies a frequency range in accordance with ITU DWDM grid spacing.

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~~47~~. The method of claim 46, wherein each frequency channel is 100 GHz wide.

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~~48~~. A method of improving signal-to-noise ratio in a received multichannel optical data signal, the multichannel optical data signal including a plurality of frequency channels, each channel including a side carrier and two data bands, the method comprising the steps of:

in each channel, separating the side carrier from the data bands;

increasing an amplitude of each side carrier; and

for each channel, recombining the side carrier with the data bands, the amplitude of each side carrier being increased relative to the data bands.

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~~49~~. The method of claim 48, wherein each frequency channel occupies a frequency range in accordance with ITU DWDM grid spacing.

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~~50~~. The method of claim 49, wherein each frequency channel is 100 GHz wide.

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~~51~~. A method of correcting in-phase and quadrature data signals for effects of chromatic dispersion prior to modulation onto an optical data signal, comprising the steps of:

providing in-phase and quadrature data signals; and

applying a corrective function to the in-phase and quadrature data signals, the corrective function modifying the in-phase and quadrature data signals in a manner that precisely counteracts effects of chromatic dispersion occurring when the in-phase an quadrature data signals are modulated onto the optical data signal and transmitted across optical fiber.